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Kawano

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(54) **IMAGE INPUT APPARATUS HAVING INTERCHANGEABLE IMAGE PICKUP DEVICE AND PAN HEAD**

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(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(51) **Int. Cl.**[7] **H04N 5/232**; H04N 5/225; H04N 7/18

(52) **U.S. Cl.** **348/211**; 348/373; 348/214; 348/143

(58) **Field of Search** 348/211, 214, 348/552, 143, 373, 376, 15, 14.08, 14.09, 141; 352/243, 242, 244; 396/424, 427, 532, 71, 419, 428, 422

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(57) **ABSTRACT**

An image input apparatus has a pan head for mounting an image pickup device thereon and for changing the image pickup direction of the image pickup device. The image pickup device has an engaging device, and control terminals capable of transmitting specification information about an operation of the pan head from the image pickup device to the pan head. The pan head has a holding device to be engaged with the engaging device so as to interchangeably hold the image pickup device, identifying terminals capable of receiving the specification information when the image pickup device is held by the holding device, and a selection circuit for selecting an operation of the pan head corresponding to the held image pickup device based on the received specification information.

62 Claims, 13 Drawing Sheets

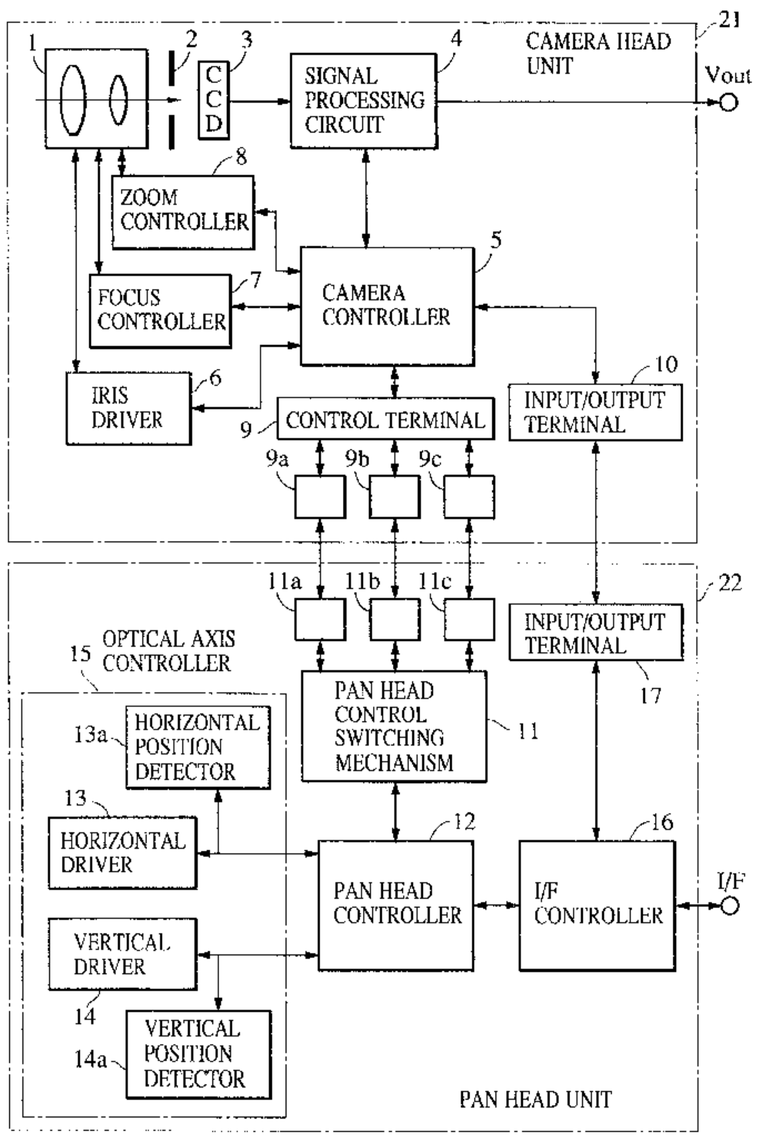


FIG. 1

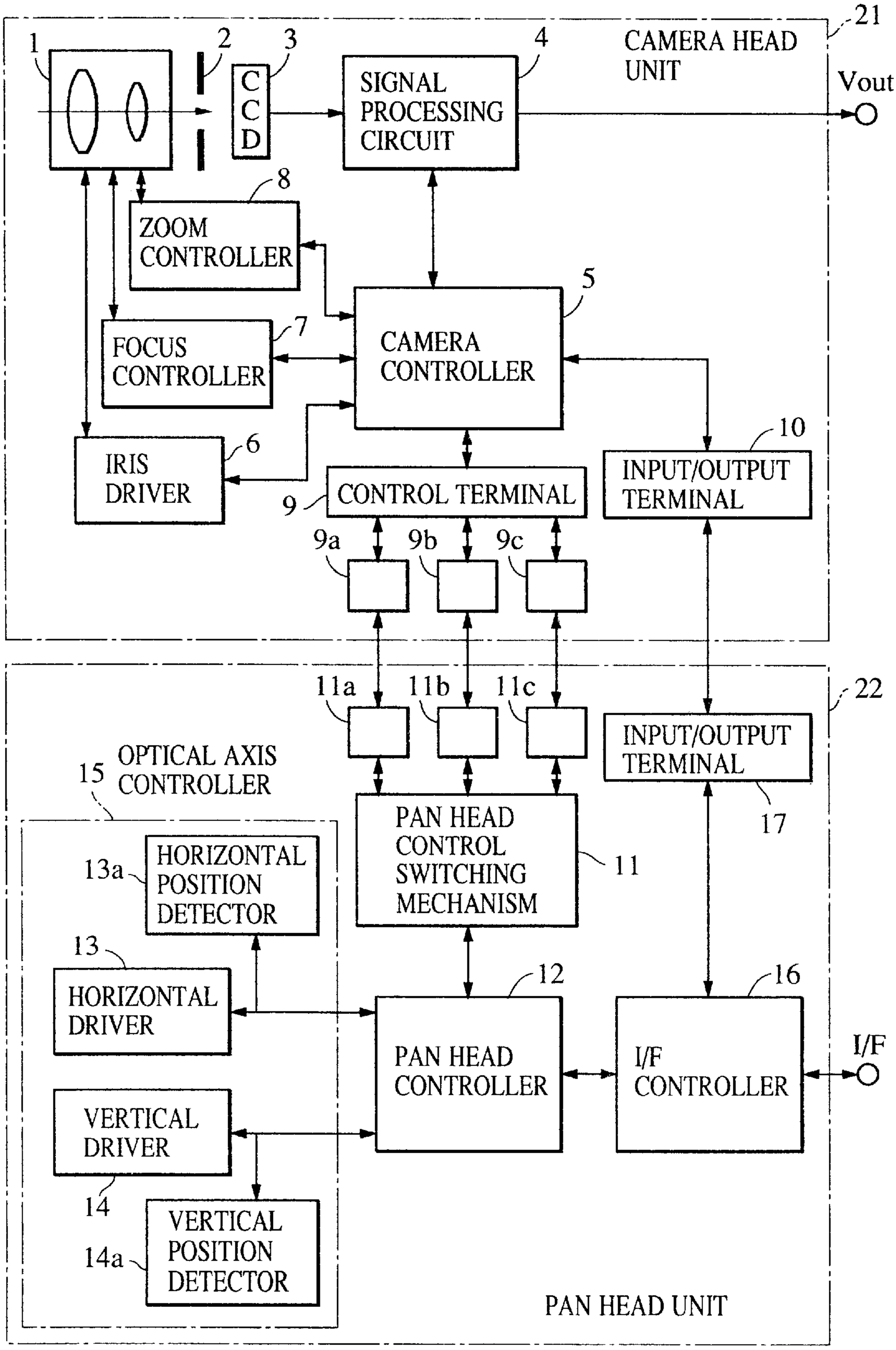

21
CAMERA HEAD UNIT
1
2
3
CCD
4
SIGNAL PROCESSING CIRCUIT
Vout
8
ZOOM CONTROLLER
5
CAMERA CONTROLLER
7
FOCUS CONTROLLER
6
IRIS DRIVER
10
INPUT/OUTPUT TERMINAL
9
CONTROL TERMINAL
9a
9b
9c
11a
11b
11c
22
INPUT/OUTPUT TERMINAL
17
15 OPTICAL AXIS CONTROLLER
PAN HEAD CONTROL SWITCHING MECHANISM
11
13a
HORIZONTAL POSITION DETECTOR
13
HORIZONTAL DRIVER
12
16
PAN HEAD CONTROLLER
I/F CONTROLLER
I/F
VERTICAL DRIVER
14
14a
VERTICAL POSITION DETECTOR
PAN HEAD UNIT

FIG. 2

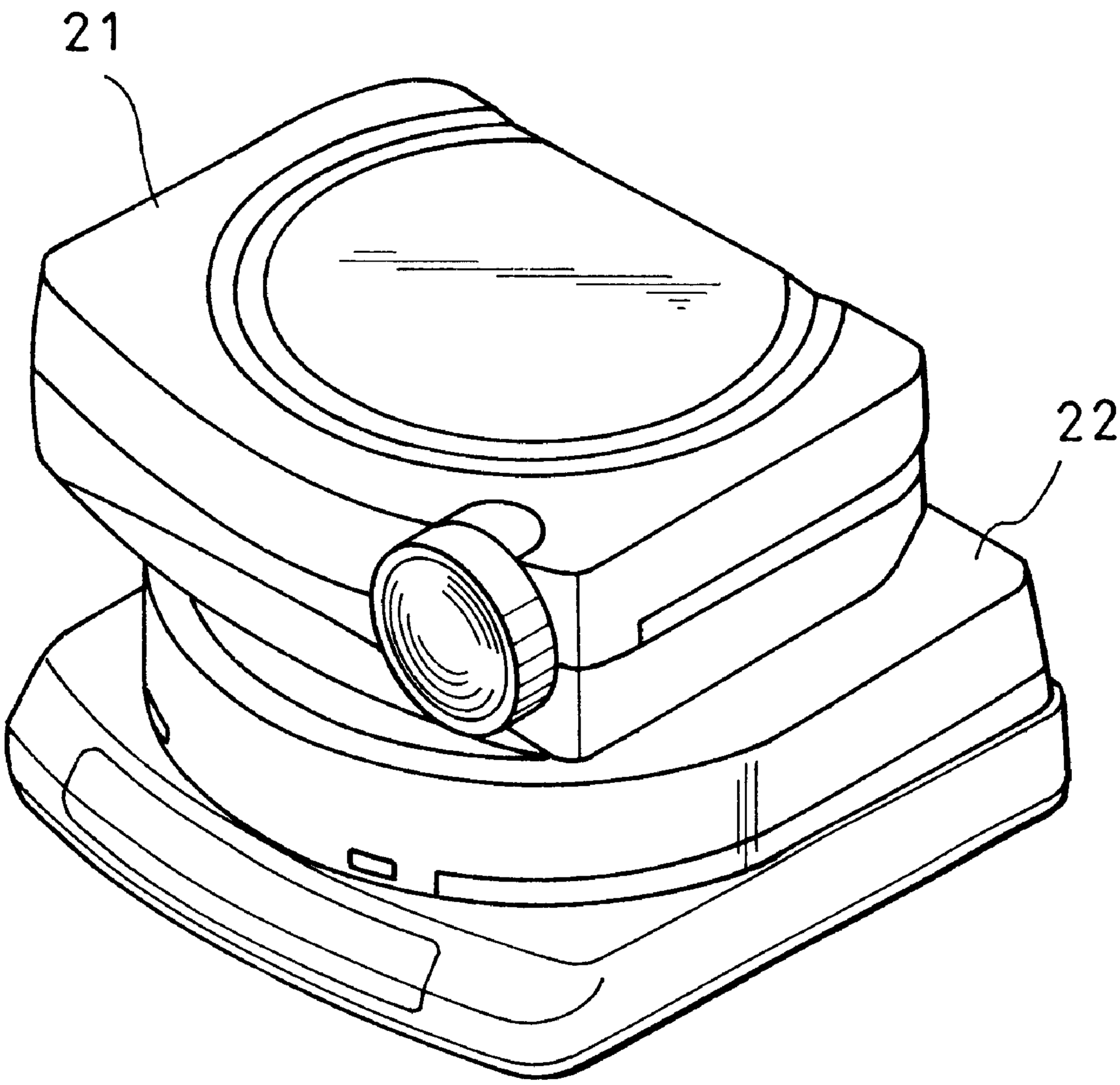


FIG. 3

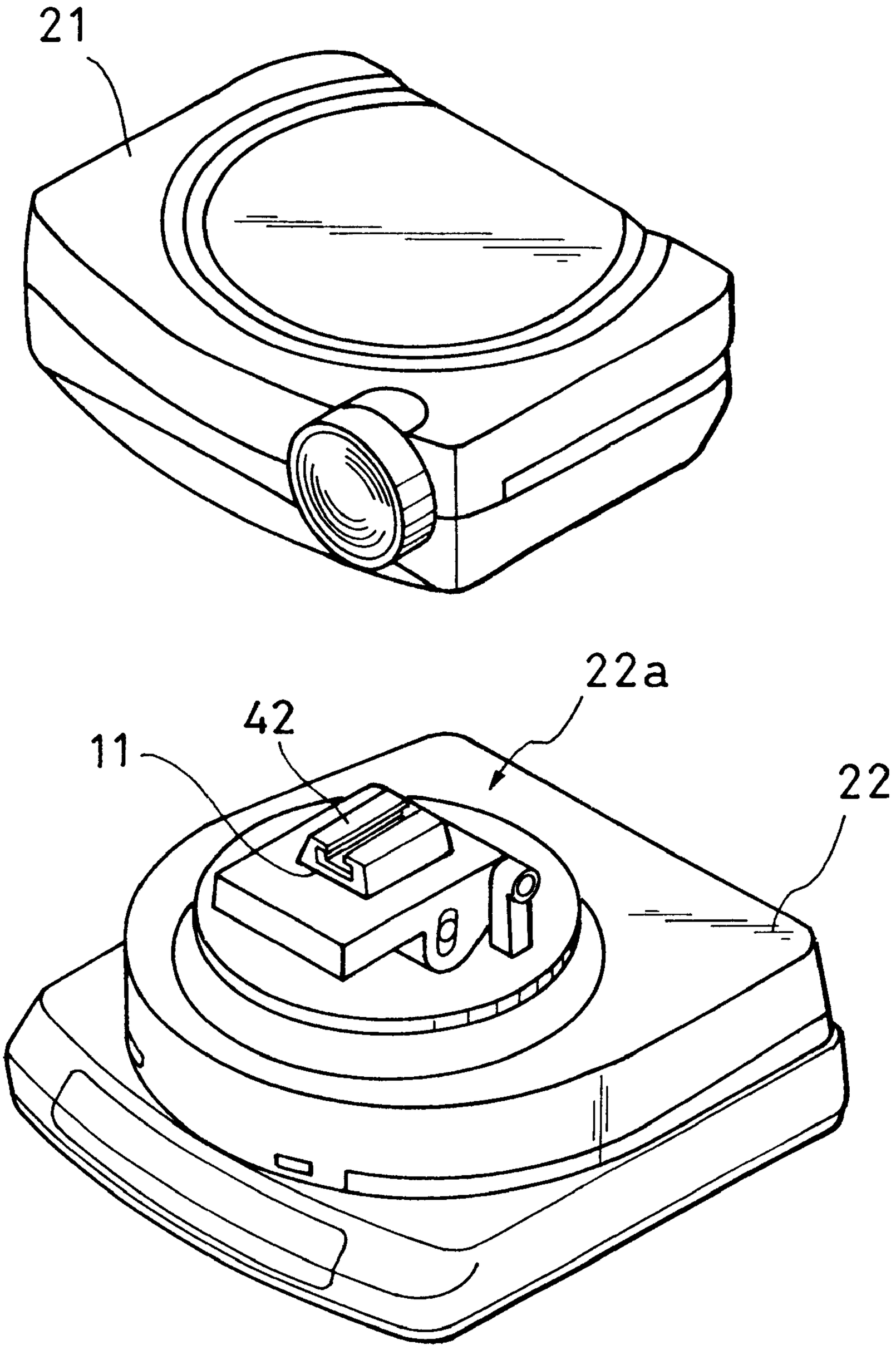


FIG. 4

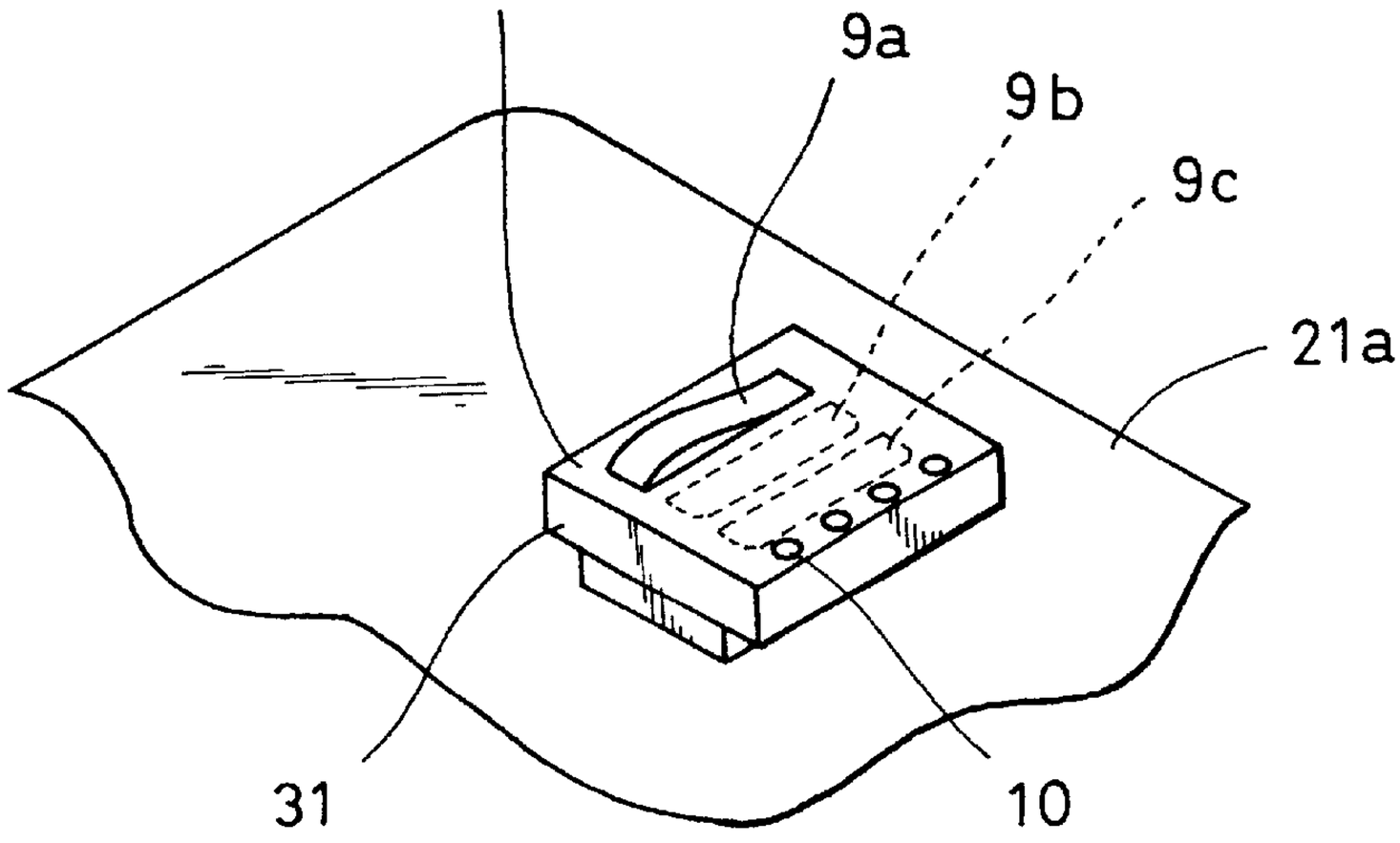


FIG. 5

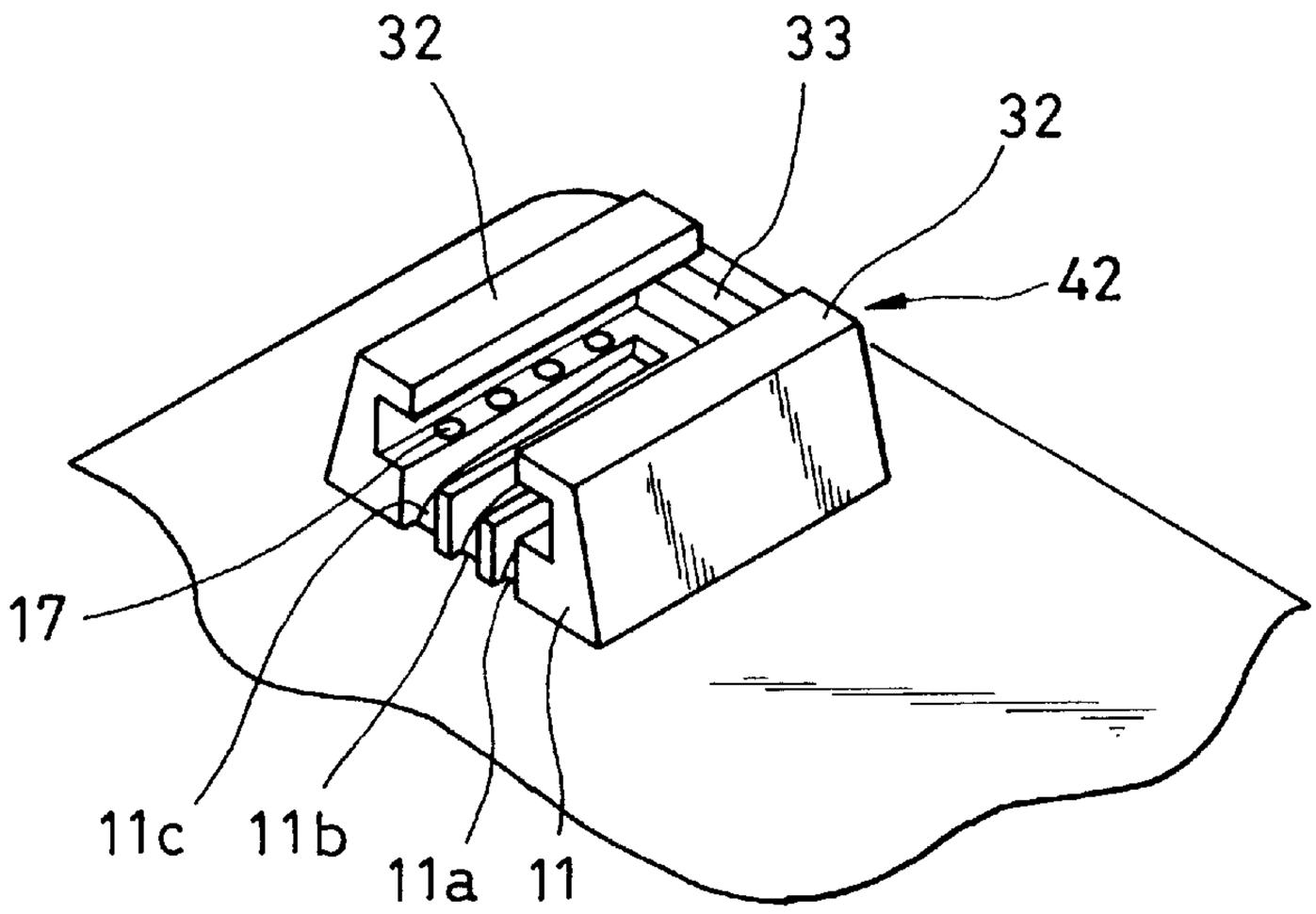


FIG. 6

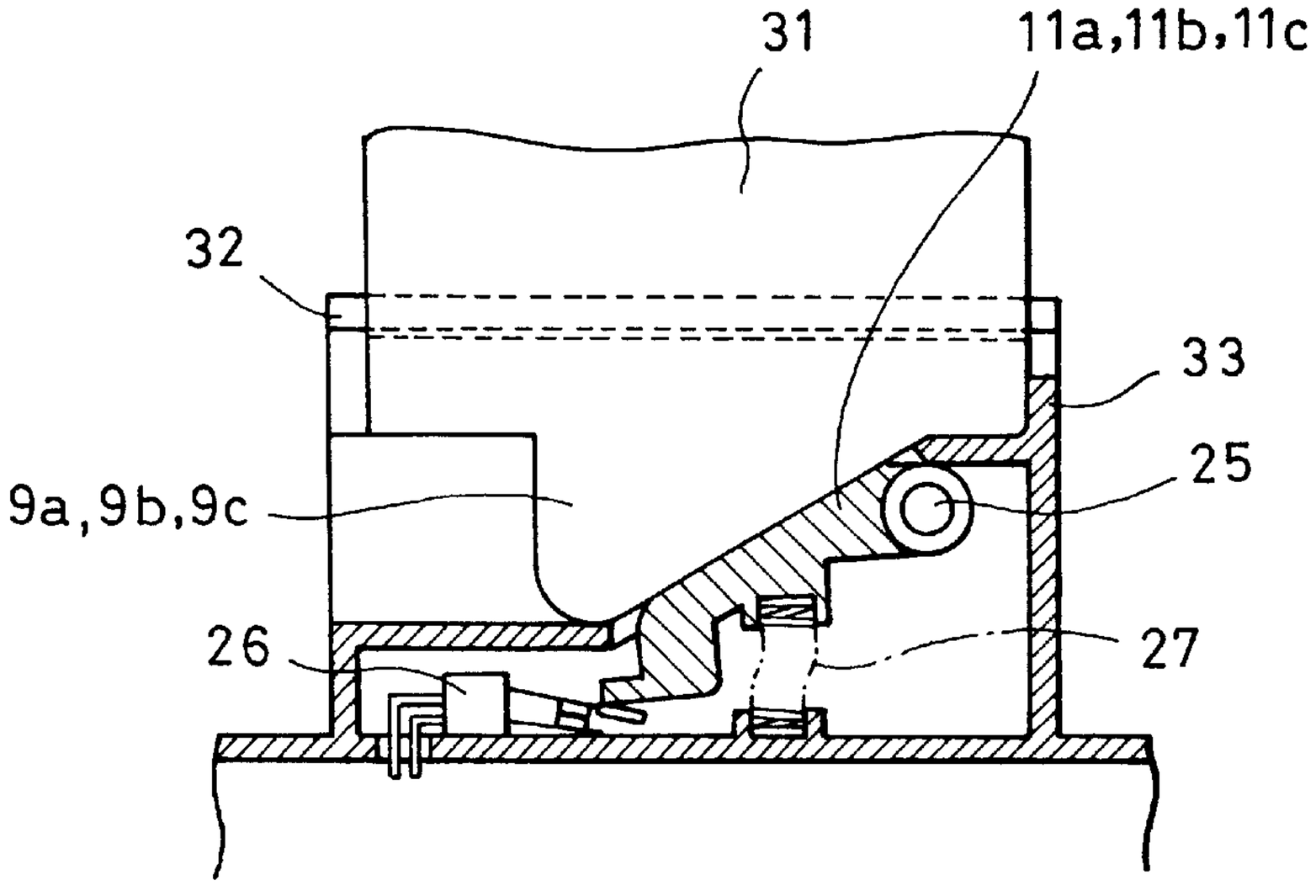
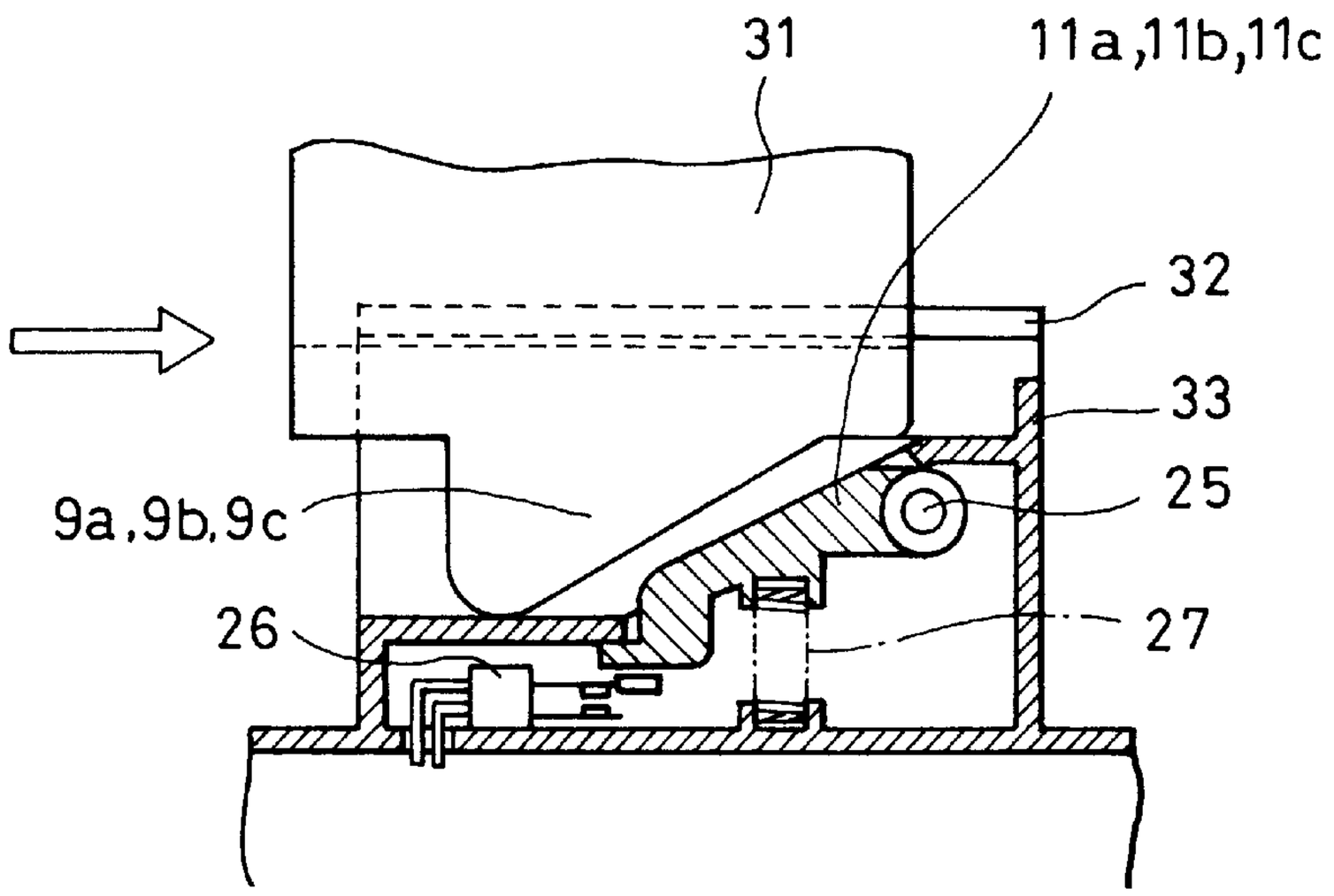

31
11a,11b,11c
32
33
25
9a,9b,9c
26
27

FIG. 7


31
11a,11b,11c
32
33
25
9a,9b,9c
26
27

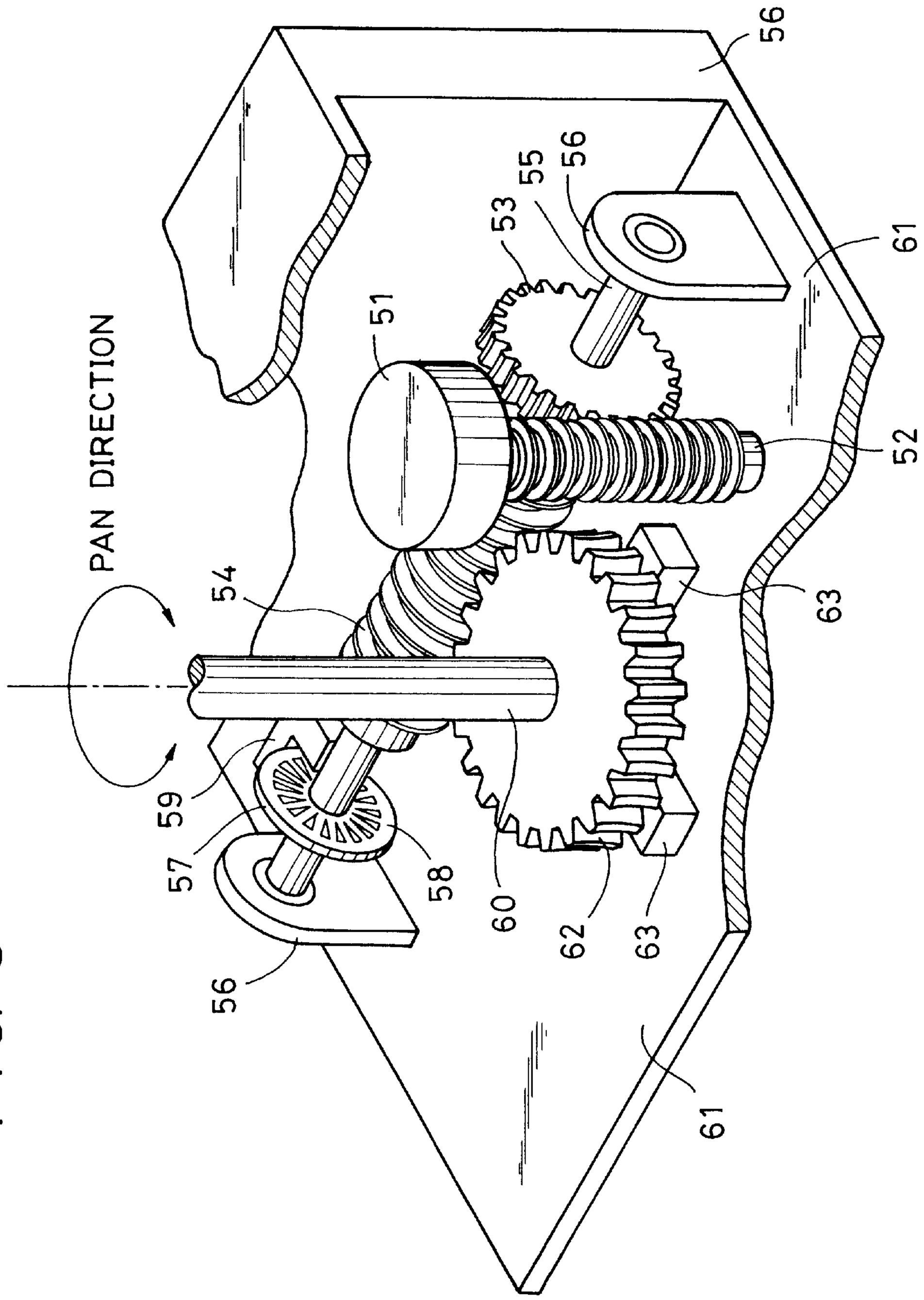


FIG. 8

FIG. 9

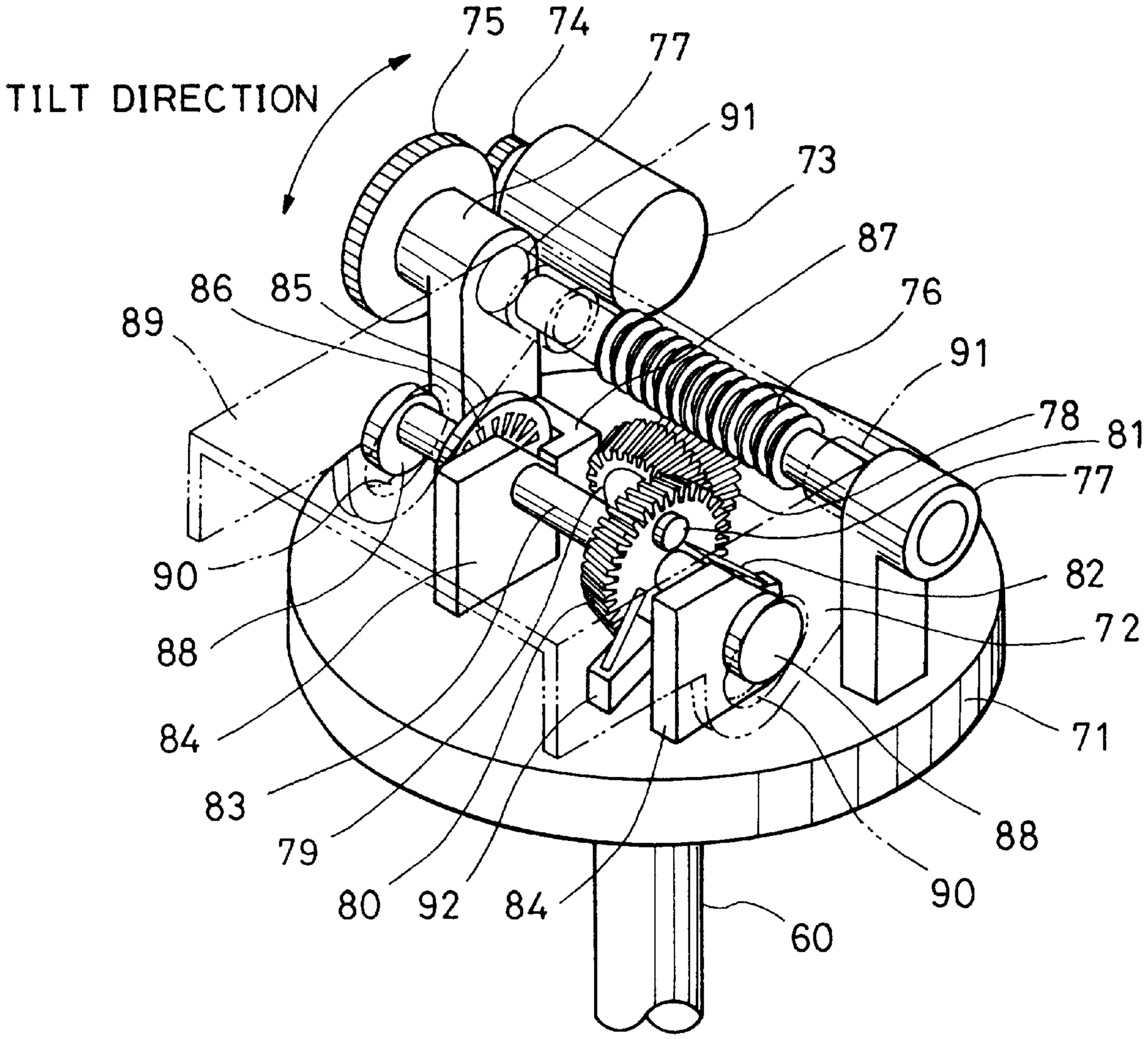

TILT DIRECTION
75
74
77
91
73
87
86
85
76
89
91
78
81
77
90
82
72
88
84
71
83
79
88
80
92
84
90
60

FIG. 10

PAN HEAD SWITCH				CAMERA HEAD UNIT	
	11(a)	11(b)	11(c)	LENS WEIGHT	FOCAL LENGTH
M1	ON	OFF	OFF	BELOW 300g	STANDARD
M2	ON	OFF	ON	ABOVE 300g BELOW 600g	STANDARD
M3	ON	ON	OFF	ABOVE 600g	STANDARD
M4	ON	ON	ON	BELOW 300g	WIDE ANGLE
M5	OFF	OFF	ON	ABOVE 300g BELOW 600g	WIDE ANGLE
M6	OFF	ON	OFF	ABOVE 300g BELOW 600g	TELEPHOTO
M7	OFF	ON	ON	ABOVE 600g	TELEPHOTO
M8	OFF	OFF	OFF	NOT MOUNTED	

FIG. 11

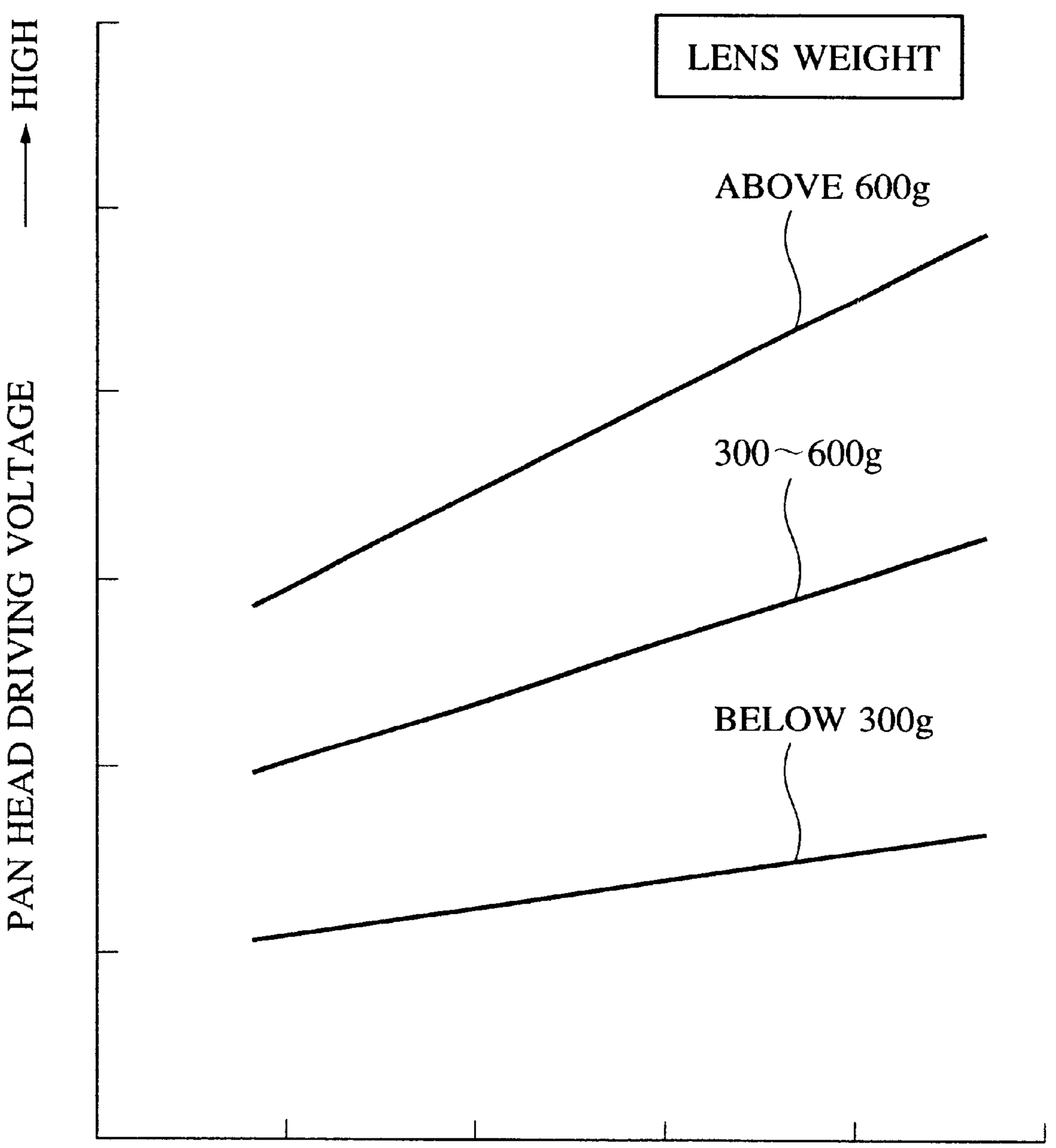

LENS WEIGHT
ABOVE 600g
300～600g
BELOW 300g
PAN HEAD DRIVING VOLTAGE → HIGH
PAN HEAD DRIVING SPEED → HIGH

FIG. 12

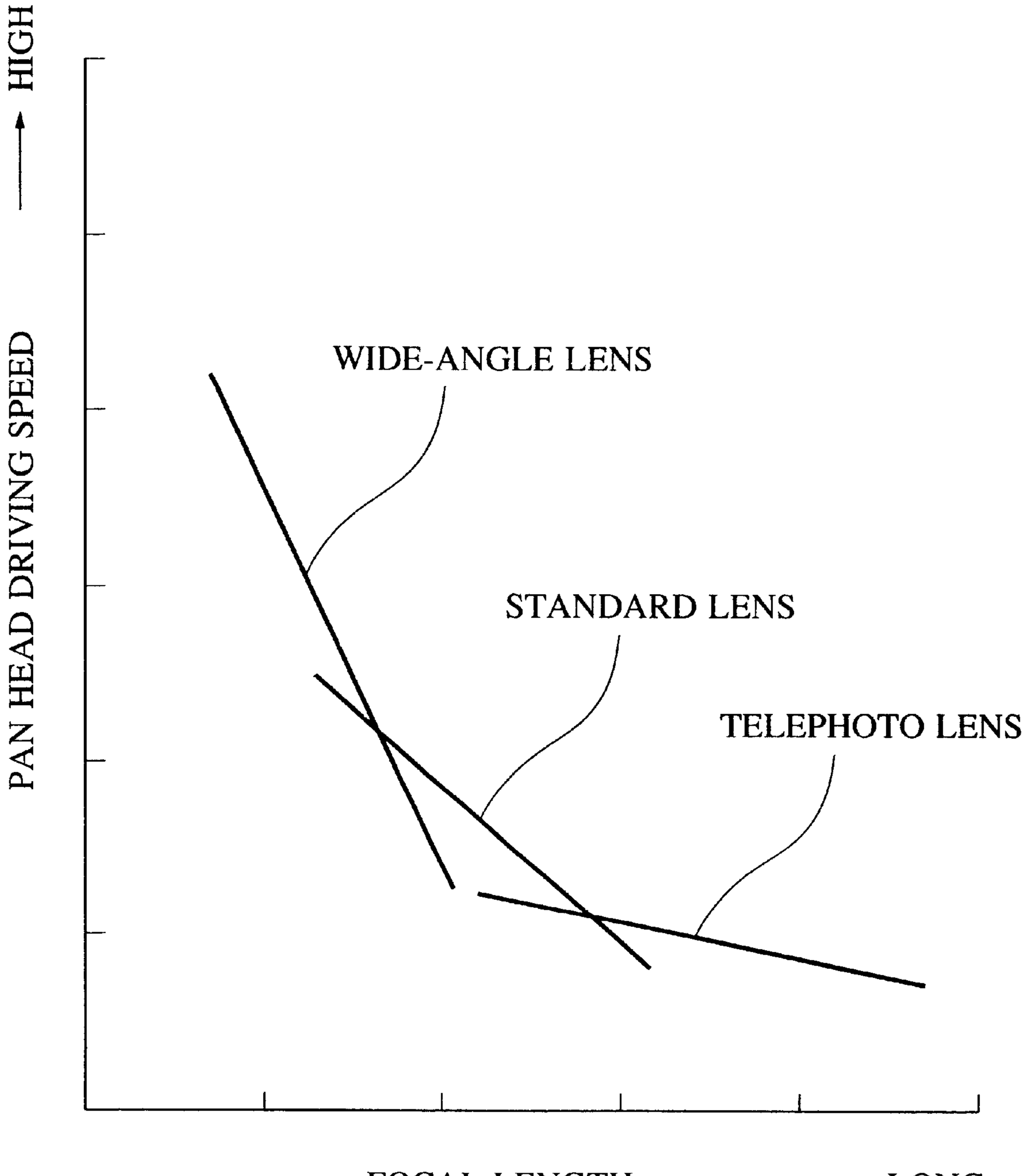

PAN HEAD DRIVING SPEED ⟶ HIGH
WIDE-ANGLE LENS
STANDARD LENS
TELEPHOTO LENS
FOCAL LENGTH ⟶ LONG

FIG. 13

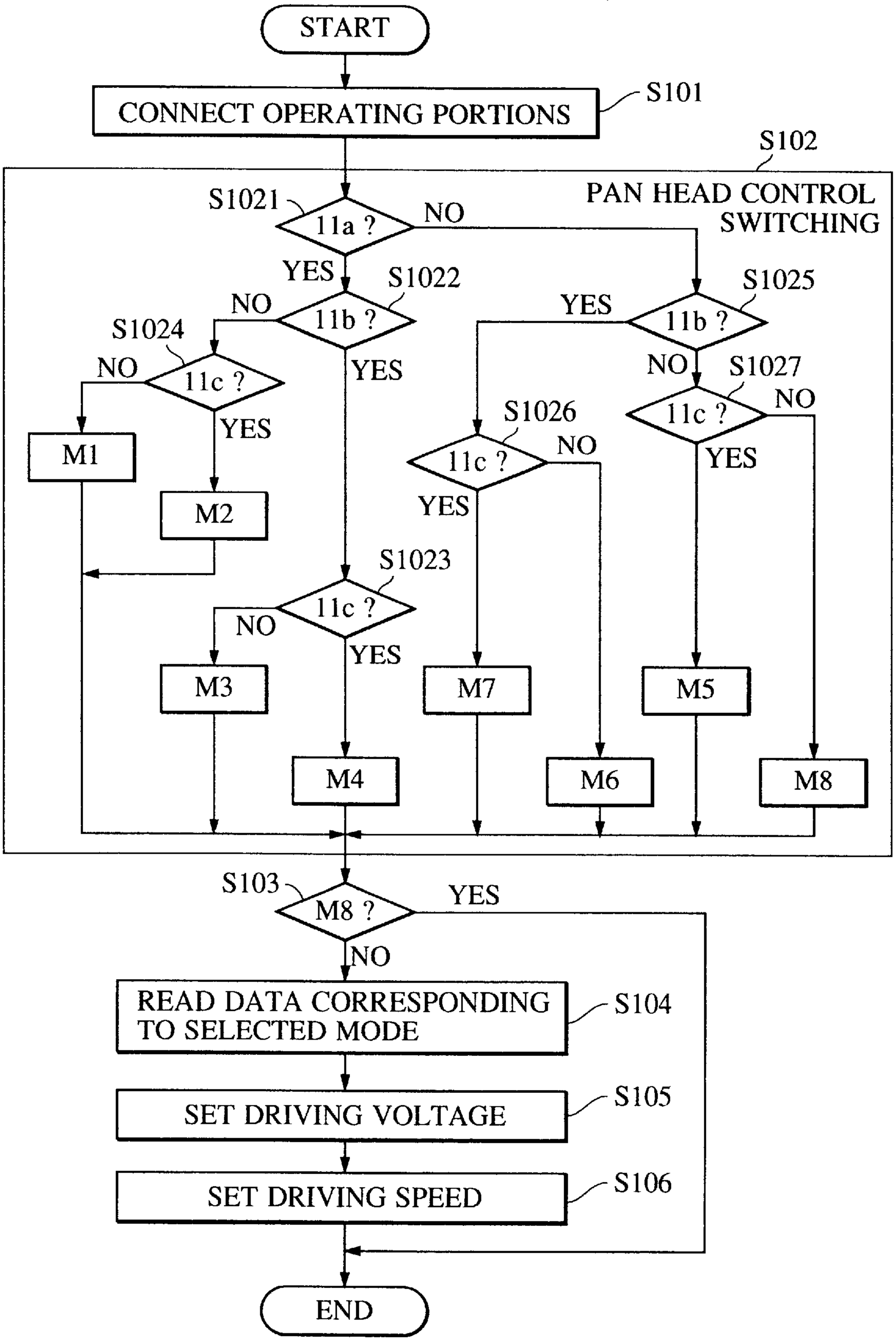

START
CONNECT OPERATING PORTIONS
S101
S102
PAN HEAD CONTROL SWITCHING
S1021
11a ?
NO
YES
S1022
11b ?
NO
YES
S1024
11c ?
NO
YES
M1
M2
S1023
11c ?
NO
YES
M3
M4
S1025
11b ?
YES
NO
S1026
11c ?
NO
YES
M7
M6
S1027
11c ?
NO
YES
M5
M8
S103
M8 ?
YES
NO
READ DATA CORRESPONDING TO SELECTED MODE
S104
SET DRIVING VOLTAGE
S105
SET DRIVING SPEED
S106
END

FIG. 14

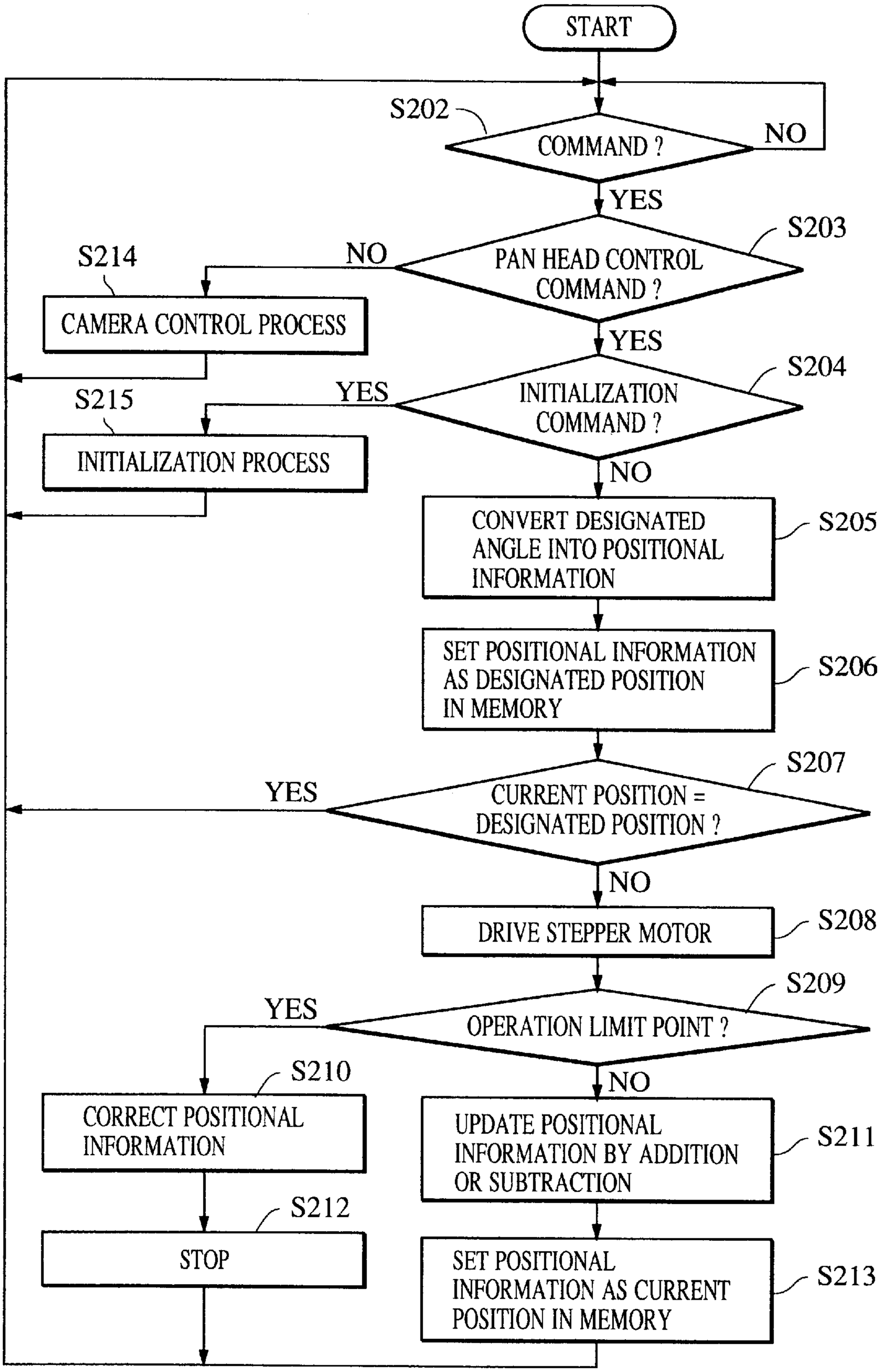

START
S202
COMMAND ?
NO
YES
S203
PAN HEAD CONTROL COMMAND ?
NO
S214
CAMERA CONTROL PROCESS
YES
S204
INITIALIZATION COMMAND ?
YES
S215
INITIALIZATION PROCESS
NO
CONVERT DESIGNATED ANGLE INTO POSITIONAL INFORMATION
S205
SET POSITIONAL INFORMATION AS DESIGNATED POSITION IN MEMORY
S206
S207
CURRENT POSITION = DESIGNATED POSITION ?
YES
NO
DRIVE STEPPER MOTOR
S208
S209
OPERATION LIMIT POINT ?
YES
NO
S210
CORRECT POSITIONAL INFORMATION
UPDATE POSITIONAL INFORMATION BY ADDITION OR SUBTRACTION
S211
S212
STOP
SET POSITIONAL INFORMATION AS CURRENT POSITION IN MEMORY
S213

FIG. 15

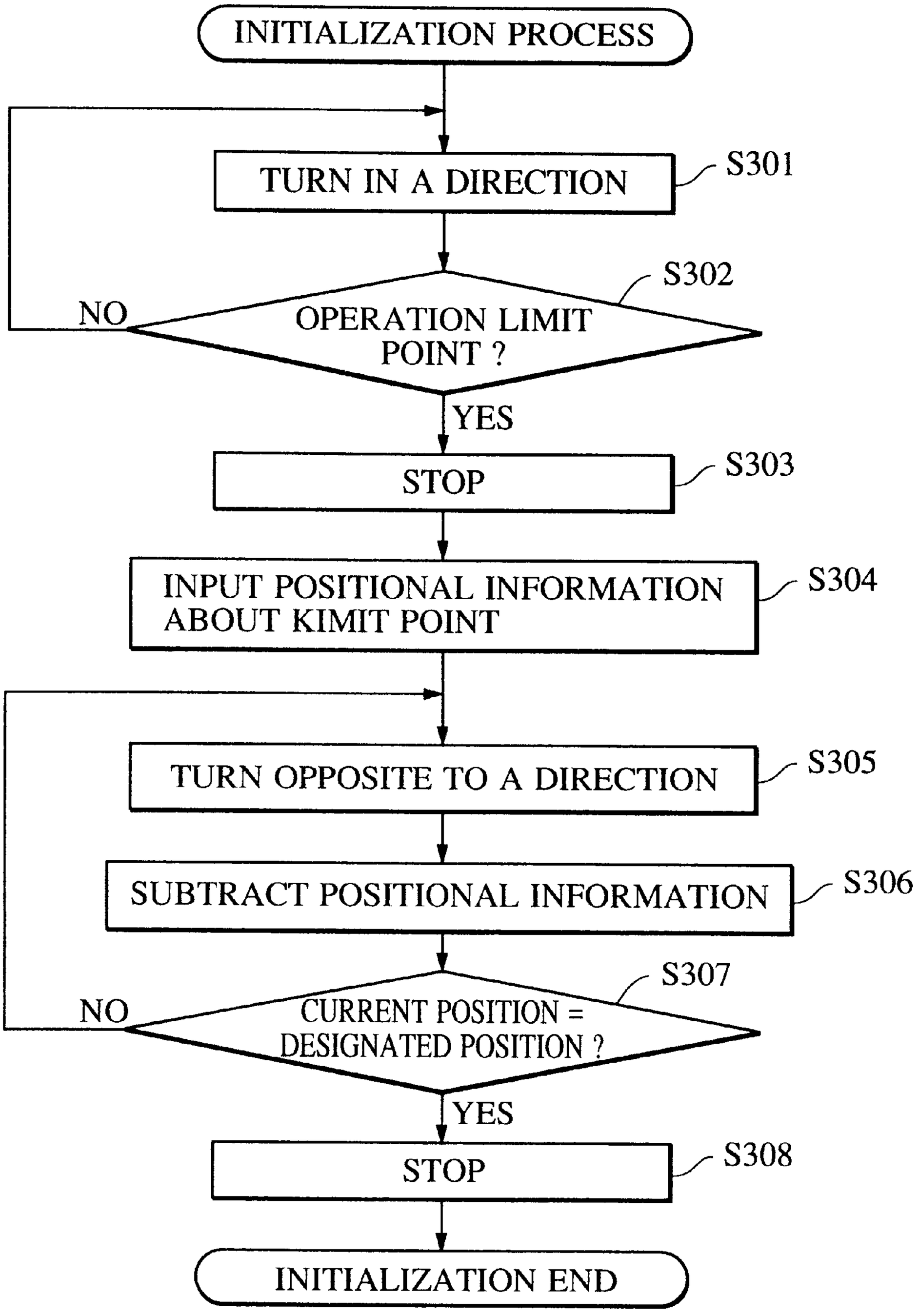

INITIALIZATION PROCESS
TURN IN A DIRECTION
S301
S302
NO
OPERATION LIMIT POINT ?
YES
STOP
S303
INPUT POSITIONAL INFORMATION ABOUT KIMIT POINT
S304
TURN OPPOSITE TO A DIRECTION
S305
SUBTRACT POSITIONAL INFORMATION
S306
S307
NO
CURRENT POSITION = DESIGNATED POSITION ?
YES
STOP
S308
INITIALIZATION END

IMAGE INPUT APPARATUS HAVING INTERCHANGEABLE IMAGE PICKUP DEVICE AND PAN HEAD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a pan head for turning a pedestal (which has a mechanism for holding an image pickup device) in at least one of the horizontal and vertical directions. The present invention also relates to an image pickup device held by such a pan head, and to an image input apparatus provided with both the pan head and the image pickup device.

2. Description of the Related Art

In recent years, a video camera which generates video signals corresponding to a subject has been widely used as an image input apparatus for a computer, and a combination system made up of this video camera and a computer (for example, a personal computer and a work station) is proceeding toward practical utilization in electronic mail for images, a videoconference system, and the like.

In these electronic image mail and video conference systems, a monitoring camera developed for monitoring, an image input apparatus equipped with a combination of a monitoring camera with a remote controlled lens and a remote controlled pan head for holding the monitoring camera, and the like are used.

For example, in a videoconference system using only a monitoring camera, the monitoring camera is fixed on the ceiling, the wall or the like so as to capture a predetermined image taking area. However, since the image taking area of the monitoring camera is thus predetermined, it is impossible to adapt to various circumstances, for example, to concentrate image taking on an arbitrary speaker, by changing the image taking area during a videoconference, which thus results in a failure to sufficiently deliver functionality with respect to the videoconference.

On the other hand, in a videoconference system using an image input apparatus equipped with a combination of a monitoring camera with a remote controlled lens and a remote controlled pan head for holding the monitoring camera, the pan head with the monitoring camera mounted thereon is fixed on the ceiling, the wall or the like, and the lens and the pan head are driven by remote control as occasion demands. Since this method can change the image taking area and direction by remote control, it is possible to readily concentrate image taking on an arbitrary speaker, or to take an image of the whole or part of a conference room, and therefore, to sufficiently deliver functionality required for the videoconference. Furthermore, a camera with a lens having an appropriate focal length can be mounted on the pan head, which allows the choice of a video camera with reference to the environment such as a conference room.

The above-mentioned image input apparatus is equipped with a pan head for interchangeably mounting a video camera thereon to choose a video camera suited to the environment. However, since the driving force of a pedestal in the pan head is set such as to cope with the heaviest video camera to be mounted thereon, a large pan head, which is high in cost, is needed. Therefore, it is difficult to obtain a low-cost image input apparatus.

Furthermore, it is necessary to change the control on the pan head in accordance with a video camera at every replacement of the video camera, and this change is troublesome.

In order to lower the cost of the pan head and to simplify the change of control on the pan head, a videoconference camera combining an image pickup device and a pan head has been developed and is nearing practical use. However, since the image pickup device and the pan head are combined in the videoconference camera, it is impossible to choose the camera with reference to the environment, such as a conference room.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an image input apparatus which solves the above problems, achieves high general versatility, reduces cost, and simplifies the change of operation control on a pan head.

In order to achieve the above object, according to an aspect of the present invention, there is provided an image input apparatus having a pan head for mounting an image pickup device thereon and for changing the image pickup direction (or orientation) of said image pickup device, wherein the image pickup device comprises an engaging portion and a transmission means capable of transmitting specification information about an operation of the pan head from the image pickup device to the pan head, and the pan head comprises a holding portion to be engaged with the engaging portion so as to interchangeably hold the image pickup device, a receiving means capable of receiving the specification information when the image pickup device is held by the holding portion, and a selection means for selecting an operation of the pan head corresponding to the held image pickup device based on the specification information received.

According to another aspect of the present invention, there is provided a pan head for mounting an image pickup device thereon and for changing the image pickup direction of the image pickup device, the pan head comprising a holding means for interchangeably holding the image pickup device, and a selection means for selecting an operation of the pan head corresponding to the image pickup device when the image pickup device is mounted on the holding means.

According to a further aspect of the present invention, there is provided an image pickup device mountable on a pan head capable of changing the image pickup direction of the image pickup device, the image pickup device comprising an engaging portion to be engaged with a holding portion provided in the pan head, and a transmission means capable of transmitting information about an operation of the pan head from the image pickup device to the pan head.

These and other objects, features and advantages of the present invention will become more apparent from the following description of the preferred embodiment taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram showing the configuration of an embodiment of an image input apparatus according to the present invention;

FIG. **2** is a perspective view showing an outward appearance of the image input apparatus shown in FIG. **1**;

FIG. **3** is a perspective view showing a state in which a camera head unit and a pan head unit of the image input apparatus shown in FIG. **1** are separate;

FIG. **4** is a perspective view showing a control terminal and an input/output terminal provided in the camera head unit of the image input apparatus shown in FIG. **1**;

FIG. **5** is a perspective view showing a terminal and an input/output terminal of a pan head control switching mechanism provided in the pan head unit of the image input apparatus shown in FIG. **1**;

FIG. **6** is a view showing a connecting state of operating portions of the control terminal of the camera head unit and the terminals of the pan head unit control switching mechanism;

FIG. **7** is a view showing a state before the operating portions of the control terminal of the camera head unit and the terminals of the pan head unit control switching mechanism are connected;

FIG. **8** is a perspective view showing the structure of a horizontal driver in the image input apparatus shown in FIG. **1**;

FIG. **9** is a perspective view showing the structure of a vertical driver in the image input apparatus shown in FIG. **1**;

FIG. **10** is a view showing patterns of pan head switching control modes in the image input apparatus shown in FIG. **1**;

FIG. **11** is a graph showing the relation between the driving speed and the driving voltage of the pan head when the weight of a lens is used as a parameter;

FIG. **12** is a graph showing the relation between the pan head driving speed and the lens focal length when the focal length is used as a parameter;

FIG. **13** is a flowchart showing a pan head control switching operation in the image input apparatus shown in FIG. **1**;

FIG. **14** is a flowchart showing an optical axis control operation in the image input apparatus shown in FIG. **1**; and

FIG. **15** is a flowchart showing an initialization process of the optical axis control operation in the image input apparatus shown in FIG. **1**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will now be described in conjunction with the accompanying drawings.

The image input apparatus shown in FIGS. **1** to **3** is composed of a camera head unit **21** and a pan head unit **22** which comprises an electric pan head for mounting the camera head unit **21** thereon.

As shown in FIG. **1**, the camera head unit **21** comprises a zoom lens **1**, an iris **2**, an image pickup device **3**, a signal processing circuit **4**, a camera controller **5**, an iris driver **6**, a focus controller **7**, and a zoom controller **8**. The camera controller **5** is capable of mutual communication with the devices and the circuits within the camera head unit **21**.

The image pickup device **3** is, for example, a CCD (charge-coupled device) for converting an optical image obtained through the zoom lens **1** into electric signals.

The signal processing circuit **4** generates video signals by subjecting the electric signals from the image pickup device **3** to predetermined processing, and outputs the video signals to an external monitor (not shown) and a video recording/reproducing apparatus (also not shown) through a terminal Vout. Parameters related to the processing performed on the electric signals from the image pickup device **3** by the signal processing circuit **4** are controlled by the camera controller **5**.

The iris driver **6** drives the iris **2** so that the amount of light passing from the zoom lens **1** to the image pickup device **3** is a predetermined amount, that is, the electric signals from the image pickup device **3** are at a substantially constant level. The drive amount of the iris **2** is designated by the camera controller **5**.

The focus controller **7** drives some of the lenses constituting the zoom leans **1** so that the zoom lens **1** is focused on a predetermined subject. The drive amount is designated by the camera controller **5**.

The zoom controller **8** drives some of the lenses constituting the zoom lens **1** to obtain a predetermined focal length of the zoom lens **1**. The drive amount is designated by the camera controller **5**.

The camera controller **5** comprises a memory (not shown) and a CPU (also not shown). The CPU determines the drive amounts of the iris driver **6**, the focus controller **7**, and the zoom controller **8** based on information from an I/F controller **16**, which will be described later, and controls the processing operation of the signal processing circuit **4**. The memory stores data on the focal length and weight of the zoom lens **1** and the like.

The camera controller **5** is provided with an input/output terminal **10** for connecting the camera controller **5** to an external device (for example, a personal computer, a work station and a codec in a videoconference system) through the I/F controller **16** to allow communication therebetween. The control terminal **9** for connecting the camera controller **5** to a pan head control switching mechanism **11** of the pan head unit **22** which will be described later. The control terminal **9** is provided with three operating portions **9***a*, **9***b* and **9***c* for setting a pan head operation with respect to the camera head unit **21**.

The control terminal **9** and the input/output terminal **10** are, as shown in FIG. **4**, formed in a support member **31** attached to the rear of a housing **21***a* of the camera head unit **21**. The operating portions **9***a*, **9***b* and **9***c* are spaced in parallel, and the shapes thereof are respectively determined in accordance with head operations set with respect to the camera head unit **21**. In this embodiment, the operating portion **9***a* is shaped like a projection, and the operating portions **9***b* and **9***c* are flat. The input/output terminal **10** is located adjacent to the operating portion **9***c*.

The pan head unit **22** is, as shown in FIG. **3**, provided with a pedestal **22***a* having a holding mechanism **42** for interchangeably holding the camera head unit **21**. The pedestal **22***a* is turned on the horizontal axis (in a pan direction) and on the vertical axis (in a tilt direction) by an optical axis controller **15**. This movement of the pedestal **22***a* changes the direction of the optical axis of the camera head unit **21**, that is, the image taking area.

The optical axis controller **15** comprises a horizontal driver **13** for driving the pedestal **22***a* in the pan direction, a horizontal position detector **13***a* for detecting the drive amount of the pedestal **22***a* in the pan direction, a vertical driver **14** for driving the pedestal **22***a* in the tilt direction, and a vertical position detector **14***a* for detecting the drive amount of the pedestal **22***a* in the tilt direction. The structures of the horizontal driver **13** and the vertical driver **14** will be described later.

The horizontal driver **13** and the vertical driver **14** are controlled by a pan head controller **12**, and the control amount is determined by using the driving voltage and the driving speed. The pan head controller **12** has a CPU (central processing unit; not shown) and a memory (also not shown). The CPU determines the aforesaid control amount for each of control modes previously stored in the memory. The control mode is selected based on a selection signal from a

pan head control switching mechanism **11** as will be described later. In this embodiment, as shown in FIG. **10**, eight control modes M**1**, . . . , M**8** are selectable with reference to the weight and the focal length of the lens **1** in the camera head unit **21**.

As the driving voltage in the control modes, one of three patterns set in accordance with the weight of the zoom lens **1** as shown in FIG. **11** is selected. The lens weight is divided into three regions, i.e., above 600 g, 600 g to 300 g and below 300 g, and the patterns of the driving voltage are set corresponding to the respective regions of the lens weight. Similarly, as the driving speed in the control modes, one of three patterns set in accordance with the focal length of the zoom lens **1** is selected as shown in FIG. **12**. The focal length of the zoom lens **1** is divided into three regions, a wide-angle lens focal length, a standard lens focal length, and a telephoto lens focal length, and the patterns of the driving speed are set corresponding to the respective regions. The driving speed is set such as to decrease as the focal length increases from the wide-angle lens to the telephoto lens.

The pan head control switching mechanism **11** provided on the holding mechanism of the pedestal **22***a* has three terminals **11***a*, **11***b* and **11***c* and an input/output terminal **17**. The terminal **11***a* is located to be opposed to the operating portion **9***a* of the control terminal **9** when the camera head unit **21** is attached to the pedestal **22***a*. Similarly, the terminals **11***b*, and **11***c* are positioned corresponding to the operating portions **9***b* and **9***c* of the control terminal **9**, respectively. The input/output terminal **17** is located to be opposed to the input/output terminal **10**.

The pan head control switching mechanism **11** also has a bracket **32** attached to the holding mechanism **42** of the pedestal **22***a* as shown in FIG. **5**. The bracket **32** comprises the terminals **11***a*, **11***b*, and **11***c*, the input/output terminal **17**, and a stopper **33** for positioning the support member **31** of the camera head unit **21**. The terminals **11***a*, **11***b* and **11***c* are spaced in parallel.

The terminals **11***a*, **11***b* and **11***c* are each, as shown in FIGS. **6** and **7**, turnably supported at one end thereof by a shaft **25** attached to the bracket **32**, urged by a spring member **27** at the center thereof, and held in such a position that the other end thereof is in contact with a part of the bracket **32** against the spring force of the spring member **27** as shown in FIG. **7**. Actuating switches **26** are respectively opposed to the other ends of the terminals **11***a*, **11***b* and **11***c*. When the terminal **11***a*, lib or **11***c* is pressed by the corresponding operating portion **9***a*, **9***b* or **9***c* as shown in FIG. **6**, the other end thereof presses the actuating switch **26**, thereby performing a turning-on operation. In other words, signals generated in response to the turning-on operations of the actuating switches **26** are given as selection signals to the pan head controller **12**, and the control mode is selected by the pan head controller **12** according to the combination of these selection signals. In short, selection signals for determining a proper control mode to the camera head unit **21** are generated by choosing respective shapes of the operating portions **9***a*, **9***b* and **9***c* such as to make the corresponding actuating switches **26** perform turning-on operations. In this embodiment, as mentioned above, eight control modes M**1**, . . . , M**8** are selectable with reference to the weight and focal length of the lens **1** in the camera head unit **1**. Since the operating portion **9***a* projects and the operating portions **9***b* and **9***c* are flat, the actuating switch **26** corresponding to the terminal **11***a* performs a turning-on operation and the actuating switches **26** corresponding to the other terminals **11***b* and **11***c* do not perform any turning-on operation, by which the control mode M**1** is selected. The control mode M**1** is set under the condition that the lens weight is less than 300 g and the focal length is standard.

When the bracket **32** is fitted on the support member **31** of the camera head unit **21**, the input/output terminal **17** is electrically connected to the input/output terminal **10**, by which the camera controller **5** and the I/F controller **16** are connected through the input/output terminals **10** and **17** so as to communicate with each other.

The I/F controller **16** receives an operation control signal from external equipment (such as a computer), and sends information about the camera head unit **21** and the pan head unit **22** to the external equipment. As is clear from the above description, the pan head controller **12** is capable of communication with other devices in the pan head unit **22**.

The structure of the horizontal driver **13** will be described in detail with reference to FIG. **8**. FIG. **8** is a perspective view showing the structure of the horizontal driver **13** in the image input apparatus shown in FIG. **1**.

The horizontal driver **13** has a stepper motor **51** supported by a support member (not shown), as shown in FIG. **8**. A worm gear **52** is attached to an output shaft of the stepper motor **51** at one end, and rotatably supported by a base **61** at the other end thereof. A helical gear **53** mounted on a shaft **55** is meshed with the worm gear **52**. Both ends of the shaft **55** are rotatably supported by corresponding support plates **56**.

A worm gear **54** and a disk **57** with a plurality of slits **58** are fixed on the shaft **55**. A helical gear **62** mounted on a shaft **60** is meshed with the worm gear **54**. The shaft **60** is supported rotatably in the pan direction by the base **61**.

The helical gear **62** is provided with a pin (not shown) which projects toward the base **61** and actuates two microswitches **63** mounted on the base **61** in correlation to the rotation of the helical gear **62**. An initial position and an operation limit point (position) in the pan direction of the shaft **60** are sensed by actuating the microswitches **63** with the pin.

The disk **57** is located orthogonal to the optical path formed by a photointerrupter **59** to open and shut the optical path. The photointerrupter **59** detects a signal in response to the opening and closing of the optical path, and the detection signal is given to the horizontal position detector **13***a*. The horizontal position detector **13***a* detects the rotation angle of the shaft **60** in the pan direction based on the detection signal from the photointerrupter **59**.

The structure of the vertical driver **14** will now be described in detail with reference to FIG. **9**. FIG. **9** is a perspective view showing the structure of the vertical driver **14** in the image input apparatus shown in FIG. **1**.

The vertical driver **14** is mounted on an operation table **71** attached to the shaft **60** of the horizontal driver **13** as shown in FIG. **9**, and provided with a stepper motor **73**.

An output shaft of the stepper motor **73** is attached to a spur gear **74** which is meshed with a spur gear **75**. The spur gear **75** is integrally fixed to a worm gear **76**. Shaft portions **91** at both ends of the worm gear **76** are rotatably supported by bearings **77** attached to the operation table **71**, respectively.

The worm gear **76** is meshed with a helical gear **78** integrally fixed to a bevel gear **79**. The bevel gear **79** is meshed with a bevel gear **80** mounted on a shaft **83**. The shaft **83** is rotatably supported at the center thereof by a bearing **84** fixed on the operation table **71**.

Elliptic cams **88** are attached to both ends of the shaft **83**, and respectively fitted in cam grooves **90** formed on a

camera head fixing plate **89**. The camera head fixing plate **89** is supported by the shaft portions **91** of the worm gear **76** so as to pivot on the shaft portions **91** in a tilt direction in correlation to the movement of the cams **88**.

The bevel gear **80** has a pin **81** which projects in parallel with the shaft **83** and actuates two microswitches **82** and **92** in correlation to the rotation of the bevel gear **80**. The microswitches **82** and **92** are mounted on the operation table **71**. An initial position and an operation limit point (position) in the tilt direction of the camera head fixing plate **89** are sensed by actuating the microswitches **82** and **92** with the pin **81**.

A disk **85** with a plurality of slits **86** is fixed on the shaft **83**.

The disk **85** is located orthogonal to the optical path formed by a photointerrupter **87** to open and shut the optical path. The photointerrupter **87** detects a signal in response to the open and shut of the optical path, and the detection signal is given to the vertical position detector **14***a*. The vertical position detector **14***a* detects the rotation angle of the camera head fixing plate **89** in the tilt direction based on the detection signal from the photointerrupter **87**.

A pan head control switching operation in the image input apparatus will now be described with reference to FIG. **13**. FIG. **13** is a flowchart showing the pan head control switching operation in the image input apparatus shown in FIG. **1**.

When the camera head unit **21** is mounted on the pan head unit **22**, as shown in FIG. **13**, the support member **31** of the camera head unit **21** (shown in FIG. **4**) is fitted in the bracket **32** of the pan head unit **22** (shown in FIG. **5**) (Step S**101**).

The terminals **11***a*, **11***b* and **11***c* are pressed by the corresponding operating portions **9***a*, **9***b* and **9***c* in correlation to the fitting of the support member **31** and the bracket **32**. Then, the actuating switches **26** are pressed by the other ends of the terminals **11***a*, **11***b* and **11***c*, thereby performing turning-on operations. In other words, signals generated by the turning-on operations of the actuating switches **26** are given as selection signals to the pan head controller **12**, and one of the control modes M**1**, . . . , M**8** is selected by the pan head controller **12** according to the combination of these selection signals (step S**102**). In this embodiment, the terminal **11***a* is pressed by the operating portion **9***a*, the actuating switch **26** corresponding to the terminal **11***a* performs a turning-on operation, and other actuating switches **26** do not perform any turning-on operations, by which the control mode M**1** is selected.

Next, it is judged whether or not the selected control mode is Mode M**8** (Step S**103**). If the selected control mode is M**8**, that is, if the camera head unit **21** is not mounted on the pan head unit **22**, the process ends.

If the selected control mode is a mode other than M**8**, data corresponding to the selected control mode is read from the memory (Step S**104**), and the driving voltage in accordance with the lens weight is set (Step S**105**). After setting the driving voltage, the driving speed in accordance with the lens focal length is set (Step S**106**).

Accordingly, when the camera head unit **21** is mounted on the pan head unit **22**, the driving voltage and driving speed best-suited to the weight and focal length of the zoom lens **1** in the camera head unit **1** are automatically selected. Specifically, when a light lens is mounted, that is, when the camera head unit **21** is light, the driving voltage is set at a low value, which achieves small power consumption and reduced noise. When a wide-angle lens is used, since the driving speed of the pan head unit **22** is set high, an arbitrary subject can be captured instantaneously. When a telephoto lens is used, a subject can be captured accurately by driving the pan head unit **22** at low speed. As mentioned above, when the camera head unit **21** is mounted on the pan head unit **22**, the optimum pan head operation with reference to the weight and focal length of the zoom lens **1** in the camera head unit **21** can be selected automatically, and the selection of the pan head operation best-suited to the camera head unit **22** can be simplified.

Since the size of the camera head unit **21** capable of being mounted on the pan head unit **22** is predetermined, there is no need to excessively increase the driving force of the pan head unit **22** and the rise in cost of the pan head unit **22** can be restricted.

Furthermore, since the pan head unit **22** interchangeably mounts the camera head unit **21** thereon, it is possible to select the camera head unit **21** having a lens suited to the intended use and to obtain high general versatility.

An optical axis control operation will now be described with reference to FIG. **14**. FIG. **14** is a flowchart showing an optical axis control operation of the image input apparatus shown in FIG. **1**.

After the camera head unit **21** is mounted on the pan head unit **22**, an external device for giving operation guidance to the camera head unit **21** and the pan head unit **22** is connected to a terminal I/F of the pan head unit **22** through a cable. After the completion of the connection, the camera head unit **21** and the pan head unit **22** are capable of operation.

Referring to FIG. **14**, first, a command from the external device is waited for (Step S**202**). When a command is input from the external device, it is judged by the I/F controller **16** whether or not the input command is a command relating to the pan head unit **22** (Step S**203**). If the input command is not a command relating to the pan head unit **22**, that is, if the input command is a command relating to the camera head unit **21**, the command is sent from the I/F controller **16** to the camera controller **5** through the input/output terminals **17** and **10**. Based on the command, the zoom operation of the zoom lens **1**, the operation of the iris **2** and the like are controlled (Step S**214**).

When the input command relates to the pan head unit **22**, it is judged whether or not the command is an initialization command (Step S**204**). If the command is an initialization command, it is sent to the pan head controller **22**, which executes an initialization process for setting the optical axis of the zoom lens **1** in an initial position (Step S**215**). The initialization process will be described in detail later.

If the input command is not an initialization command, that is, if the input command is information for designating the angle of the optical axis in the pan direction or the tilt direction, the angle designated by the command is converted into positional information (Step S**205**), and the positional information is stored as a designated position in the memory (Step S**206**).

Subsequently, it is judged whether or not the current position of the optical axis agrees with a designated position (Step S**207**). If the optical axis is currently in the designated position, the process from Step S**201** on is executed again.

If the current position of the optical axis does not agree with the designated position, the stepper motor **51** of the horizontal driver **13** or the stepper motor **73** of the vertical driver **14** is driven to start the angle adjustment in the pan direction or the tilt direction so that the optical axis reaches from the current position to the designated position (Step S**208**).

After the angle adjustment in the pan direction or the tilt direction is started, it is judged whether or not the horizontal

driver **13** or the vertical driver **14** reaches an operation limit point before the optical axis reaches from the current position to the designated position (Step S**209**). If it is judged that the horizontal driver **13** or the vertical driver **14** reaches the operation limit point before the optical axis reaches from the current position to the designated position, a positional information correction process is carried out to reset the designated position stored in the memory (Step S**210**), and the stepper motor **51** of the horizontal driver **13** or the stepper motor **73** of the vertical driver **14** is stopped (Step S**212**). After the stepper motor **51** or **73** is stopped, the process from Step S**201** on is executed again.

If it is judged that the horizontal driver **13** or the vertical driver **14** does not reach the operation limit point before the optical axis reaches from the current position to the designated position, the position of the optical axis is sequentially updated by a computation such as addition or substraction, and the stepper motor **51** of the horizontal driver **13** or the stepper motor **73** of the vertical driver **14** is driven until the optical axis reaches from the current position to the designated position (Step S**211**). When the optical axis reaches the designated position, the current position stored in the memory is updated (Step S**213**). After updating the current position, the process from Step S**201** on is executed again.

When the command input from the external device is a command for the camera head unit **21**, it is sent from the I/F controller **16** to the camera controller **5** through the input/output terminals **17** and **10**. When the input command is a command for the pan head unit **22**, it is sent from the I/F controller **16** to the pan head controller **12**. Accordingly, it is possible to combine a control line for the camera head unit **21** and a control line for the pan head unit **22** into one line, and thereby, to eliminate excess trouble of separately laying the control lines for the camera head unit **21** and the pan head unit **22** as in the conventional apparatus in which a camera can be mounted on a pan head. Furthermore, since the I/F controller **16** is set to communicate with the external device, there is no need to add a special connecting device which allows communication between the I/F controller **16** and the external device.

Next, the initialization process for the pan head unit **22** will be described with reference to FIG. **15**. FIG. **15** is a flowchart showing an initialization process in the optical axis control operation of the image input apparatus shown in FIG. **1**.

In the initialization process, initialization in the horizontal direction is first performed. When the initialization in the horizontal direction is started, as shown in FIG. **15**, directions are given to make a turn in an A direction (for example, a horizontal and clockwise direction), and the stepper motor **51** of the horizontal driver **13** is driven (Step S**301**). The drive of the stepper motor **51** in the horizontal driver **13** is continued until an operation limit point of the shaft **60** is detected in response to the actuation of the microswitch **63**. When the operation limit point is detected, the stepper motor **51** is stopped (Steps S**302** and S**303**).

When the stepper motor **51** is stopped, positional information corresponding to the operation limit point is stored in the memory (Step S**304**).

Next, directions are given to make a turn opposite to the A direction (in a horizontal and counterclockwise direction), the stepper motor **51** of the horizontal driver **13** is driven (Step S**305**), and the current positional information is calculated by subtracting positional information corresponding to the drive amount of the stepper motor **51** from the positional information stored in the memory (Step S**306**). The positional information corresponding to the drive amount of the stepper motor **51** is found from the rotation angle of the shaft **60** in the pan direction obtained based on the above-mentioned detection signal of the photointerrupter **59**.

The stepper motor **51** is driven until the calculated current positional information agrees with predetermined information designated and stored in the memory. When the current positional information agrees with the designated information stored in the memory, the stepper motor **51** is stopped (Steps S**307**, S**308**). After the stop of the stepper motor **51**, the initialization process in the horizontal direction ends.

Subsequently, initialization in the vertical direction is performed by using a similar procedure to the initialization in the horizontal direction. The description of the initialization in the vertical direction is omitted in this embodiment.

Thus, an absolute value of the optical axis of the zoom lens **1** can be detected and the direction of the optical axis can be set arbitrarily by executing the initialization process.

Although the camera head unit **21** is moved by the operation of the optical axis controller **15** in this embodiment, the camera head unit **21** and the signal processing circuit **4** may be separated from each other, a package for housing the zoom lens **1**, the image pickup device **3** and the like together may be driven by the optical axis controller **15**.

If there is no need to greatly change the image taking area (position), a driving method for changing the relative position between the zoom lens **1** and the image pickup device **3**, a method of changing the optical axis of incident light by placing a variable vertical angle prism in front of the zoom lens **1**, or a method of changing the angle relative to the optical axis by placing a plate glass member (whose opposite surfaces are parallel) in the optical path may be adopted. Furthermore, mode information stored in the memory may be read into the pan head unit when the camera head unit is mounted on the pan head unit. Still further, more accurate motion control can be exerted by storing information about the lens weight, focal length and the like in the memory, not as mode information, but as concrete numeric values.

The pan head in the above-mentioned embodiment is equipped with a holding mechanism attached to a pedestal to interchangeably hold an image pickup device, and a pan head control switching mechanism for performing switching so as to select and control a pan head operation suited to the image pickup device when the image pickup device is mounted on the holding mechanism. The pan head operation corresponding to the image pickup device is selected and carried out by a drive means based on the switching operation of the pan head control switching mechanism. Therefore, it is possible to achieve an image input apparatus which is excellent in general versatility and low in cost and is capable of changing pan head control with no trouble.

In addition, since the pan head has an input/output terminal to be connected to an input/output terminal of the image pickup device for signals relating to control when the image pickup device is mounted on the holding mechanism, the trouble of laying another control line separate from a control line for the image pickup device can be eliminated.

The individual components shown in outline or designated by blocks in the Drawings are all well-known in the image recording arts, and their specific construction and operation are not critical to the operation or best mode for carrying out the invention.

While the present invention has been described with respect to what is presently considered to be the preferred

embodiments, it is to be understood that the invention is not limited to the disclosed embodiments. To the contrary, the invention is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

What is claimed is:

1. A pan head for mounting an image pickup device thereon and for changing the image pickup direction of the image pickup device, said pan head comprising:

(a) a holding member for selectively holding one of a plurality of different image pickup devices each of which has a control mode which is different from the other image pickup devices;

(b) a receiving device that receives from the attached image pickup device an identifying signal that identifies the type of image pickup device being held by said holding member, the identifying signal specifying a pan head operation.

2. A pan head according to claim **1**, further comprising a selection device that selects a pan head operation corresponding to the image pickup device mounted on said holding member.

3. A pan head according to claim **2**, wherein said selection device generates information used to select the pan head operation based on the identifying signal received by said receiving device.

4. A pan head according to claim **3**, further comprising a drive device that executes the pan head operation based on the selection of said selection device.

5. A pan head according to claim **4**, further comprising a memory that stores data on operations of said pan head corresponding to different image pickup devices.

6. A pan head according to claim **5**, wherein said drive device reads out data on the pan head operation from said memory based on the selection of said selection device when the image pickup device is mounted on said holding member.

7. A pan head according to claim **6**, wherein the data on the operation of said pan head comprises data representing at least either the driving voltage or the driving speed of said drive device.

8. A pan head according to claim **1**, wherein the image pickup device has a plurality of control terminals for providing the identifying signal, and wherein said receiving device has a plurality of identifying terminals corresponding to the plurality of control terminals of the image pickup device.

9. A pan head according to claim **1**, further comprising a plurality of terminals that contacts a corresponding plurality of terminals on the image pickup device, and a plurality of switches respectively coupled to the plurality of pan head terminals, said switches outputting the identifying signal, which identifies operational characteristics of the image pickup device.

10. A pan head according to claim **9**, wherein said pan head terminals are disposed in said holding member.

11. A pan head according to claim **9**, wherein said detecting device judges a connection state between the terminals when the image pickup device is mounted on said holding member.

12. A pan head according to claim **1**, wherein the image pickup device has a lens mounted thereon, and wherein the identifying signal comprises information representing at least either a weight or a focal length of the lens mounted on the image pickup device.

13. A pan head according to claim **1**, wherein the image pickup device has an input/output terminal for providing a control signal relating to control of the image pickup device, and further comprising a pan head input/output terminal to be connected to the input/output terminal of the image pickup device for receiving the signal relating to control of the image pickup device when the image pickup device is mounted on said holding member.

14. An image pickup device mountable on a pan head which is capable of changing an image pickup direction of said image pickup device, the pan head having a holding member which detachably holds one of a plurality of image pickup devices each of which has a control mode different from each other, said image pickup device comprising:

(a) an engaging member engageable with the holding member of the pan head; and

(b) a transmission device that transmits from the image pickup device to the pan head an identifying signal that identifies the type of image pickup device engaged with the holding member, the identifying signal specifying an operation of the pan head with said image pickup device.

15. An image pickup device according to claim **14**, wherein said transmission device has a control terminal for specifying an operation of the pan head.

16. An image pickup device according to claim **14**, wherein the pan head has an input/output terminal, and further comprising an image pickup device input/output terminal to be connected to the input/output terminal of the pan head, for transmitting to the pan head input/output terminal a signal relating to the control of said image pickup device when said image pickup device is mounted on the holding member.

17. An image input apparatus having a pan head for mounting an image pickup device thereon and for changing the image pickup direction of said image pickup device, said image input apparatus comprising:

(a) said image pickup device comprising:

an engaging member; and

a transmission device that transmits from the image pickup device to said pan head specification information which specifies the control mode of an operation of said pan head with said image pickup device before an image pickup operation of the attached image pickup device is started, said specification information comprising an identification signal identifying said image pickup device,

(b) said pan head comprising:

a holding member being engageable with said engaging member to interchangeably connect said pan head with one of a plurality of image pickup devices each of which has a control mode different from each other;

a receiving device that receives from said transmission device the specification information of the control mode of the image pickup device; and

a selection device that selects an operation of said pan head corresponding to the connected image pickup device based on the received specification information.

18. An image input apparatus according to claim **17**, wherein said selection device provides selection information for selecting the operation of said pan head based on the specification information received by said receiving device.

19. An image input apparatus according to claim **18**, further comprising a pan head drive device that executes the operation of said pan head based on the selection information of said selection device.

20. An image input apparatus according to claim **19**, further comprising a pan head memory that stores data on operations of said pan head corresponding to different image pickup devices.

21. An image input apparatus according to claim **20**, wherein said drive device (i) reads out from said memory data on the operation of said pan head based on the selection information when said image pickup device is mounted on said holding member, and (ii) executes the operation of said pan head based on the read data.

22. An image input apparatus according to claim **21**, wherein the data on the operation of said pan head comprises data representing at least either the driving voltage or the driving speed of said drive device.

23. An image input apparatus according to claim **17**, wherein said image pickup device includes a lens mounted thereon, and wherein the specification information for specifying the operation of said pan head comprises information representing at least either a weight or a focal length of the lens.

24. An image input apparatus according to claim **17**, wherein said transmission device has a plurality of control terminals that transmits the specification information, and wherein said receiving device has a plurality of identifying terminals corresponding to said plurality of control terminals.

25. An image input apparatus according to claim **24**, wherein said selection device (i) determines a connection state between said control terminals and said identifying terminals when said image pickup device is mounted on said holding member, and (ii) generates the selection information based on the determination result.

26. An image input apparatus according to claim **17**, further comprising a connecting device that transmits from said pan head to said image pickup device a signal that controls said image pickup device when said image pickup device is mounted on said holding member.

27. A pan head according to claim **1**, wherein the identifying signal corresponds to a weight of said image pickup device.

28. A pan head according to claim **27**, further comprising a pan head controller that controls pan head movement in accordance with the weight of the image pickup device.

29. A pan head according to claim **1**, wherein the identifying signal identifies at least one of (i) a weight and (ii) a focal length of said image pickup device, said pan head further comprising:

a pan head memory that stores pan head driving data regarding at least one of (i) image pickup device weight and (ii) image pickup device focal length; and

a pan head controller that controls a driving operation of said pan head based on the stored pan head driving data and the identifying signal received from the image pickup device.

30. A pan head according to claim **29**, wherein said identifying signal corresponds to the weight of the image pickup device, and wherein the stored pan head driving data corresponds to pan head driving voltage.

31. A pan head according to claim **29**, wherein said identifying signal corresponds to the focal length of the image pickup device, and wherein the stored pan head driving data corresponds to pan head driving speed.

32. An image pickup device according to claim **14**, wherein said transmission device comprises a plurality of differently-shaped terminals whose shapes correspond to operational characteristics of said image pickup device.

33. An image pickup device according to claim **32**, wherein said plurality of terminals are disposed in said engaging member.

34. An image pickup device mountable on a pan head which is capable of changing an image pickup direction of said image pickup device, the pan head having a holding member, said image pickup device comprising:

(a) an engaging member engageable with the holding means of the pan head; and

(b) a transmission device that transmits from the image pickup device directly to the pan head information about an operation of the pan head with said image pickup device, said information comprising a non-video signal, wherein said transmission device comprises a plurality of differently-shaped terminals whose shapes correspond to operational characteristics of said image pickup device,

wherein the plurality of terminals have a pattern of different shapes based on the weight of the image pickup device.

35. An image pickup device according to claim **32**, wherein the plurality of terminals have a pattern of different shapes based on a focal length of the image pickup device.

36. An image pickup device according to claim **14**, further comprising a camera controller for controlling camera operations based on a signal output from a controller of the pan head.

37. An image input apparatus according to claim **17**, wherein said transmission device comprises a plurality of differently-shaped terminals, the shape of the terminals corresponding to an operational characteristic of said image pickup device, and wherein said selection device detects the different shapes of the image pickup device terminals and varies the operation of the pan head based on the shape of the image pickup device terminals.

38. An image input apparatus having a pan head for mounting an image pickup device thereon and for changing the image pickup direction of the image pickup device, said image input apparatus comprising:

(a) said image pickup device comprising:

an engaging member; and

a transmission device that transmits from the image pickup device directly to said pan head specification information which specifies an operation of said pan head with said image pickup device, said specification information comprising an identification signal identifying said image pickup device,

(b) said pan head comprising:

a holding member engageable with said engaging member to interchangeably connect said image pickup device and said pan head;

a receiving device that receives directly from said transmission device the specification information when said image pickup device is connected to said holding member; and

a selection device that selects an operation of said pan head corresponding to the connected image pickup device based on the received specification information, said selection device automatically varying an operation of said pan head based on the identification signal,

wherein said image pickup device transmission device comprises a plurality of differently-shaped terminals, the shape of the terminals corresponding to an operational characteristic of said image pickup device, and wherein said pan head selection device detects the different shapes of the image pickup device terminals and varies the operation of the pan head based on the shape of the image pickup device terminals,

wherein the shape of the image pickup device terminals corresponds to a weight of the image pickup device

and wherein said pan head selection device automatically varies an operation of the pan head based on the weight of the image pickup device.

39. An image input apparatus according to claim **38**, wherein said selection device varies a pan head driving voltage based on the weight of the image pickup device.

40. An image input apparatus according to claim **37**, wherein the shape of the image pickup device terminals corresponds to a focal length of the image pickup device, and wherein said pan head selection device automatically varies an operation of the pan head in accordance with the focal length of the image pickup device.

41. An image input apparatus according to claim **40**, wherein the pan head selection device varies a driving speed of the pan head based on the focal length of the image pickup device.

42. An image input apparatus according to claim **17**, wherein said engaging member includes a plurality of terminals which connect with a corresponding plurality of terminals in said pan head holding member, the specification information being transmitted from the image pickup device terminals to the pan head terminals.

43. An image pickup device mountable on a pan head which controls said image pickup device, said image pickup device comprising:

a transmission device that transmits information from the image pickup device to said pan head, said information comprising information regarding the weight of the image pickup device.

44. A pan head according to claim **1**, wherein the identifying signal comprises a non-video signal which comprises information regarding a range for changing the focal length.

45. An image pickup device according to claim **14**, wherein the identifying signal comprises a non-video signal which distinguishes the attached image pickup device from other image pickup devices and comprises information regarding a range for changing the focal length.

46. An image pickup device according to claim **43**, wherein said information comprises the weight of a lens of said image pickup device.

47. An image pickup device according to claim **43**, wherein said pan head changes a driving voltage for changing a direction of the image pickup device based on said information.

48. An image pickup device according to claim **43**, wherein said pan head changes a driving speed for changing a direction of the image pickup device based on said information.

49. A pan head for mounting an image pickup device thereon and for controlling said image pickup device, said pan head comprising:

a holding device the interchangeably holds the image pickup device; and

a receiving device that receives information comprising information regarding the weight of said image pickup device.

50. A pan head according to claim **49**, wherein said information comprises the weight of a lens of said image pickup device.

51. A pan head according to claim **49**, further comprising:

a driving device that drives the pan head based on said information.

52. A pan head according to claim **51**, wherein said driving device changes a driving voltage for changing a direction of the image pickup device based on said information.

53. A pan head according to claim **51**, wherein said driving device changes a driving speed for changing a direction of the image pickup device based on said information.

54. A control method for controlling a pan head on which an image pickup device is mounted, the method comprising the steps of:

receiving information from the image pickup device, said information comprising information regarding a weight of the image pickup device; and

controlling said pan head based on said information.

55. A method according to claim **54**, wherein said information comprises the weight of a lens of said image pickup device.

56. A method according to claim **54**, further comprising:

controlling a driving voltage of said pan head for changing a direction of the image pickup device based on said information.

57. A method according to claim **54**, further comprising:

controlling a driving speed of said pan head for changing a direction of the image pickup device based on said information.

58. A control method for controlling a pan head on which an image pickup device is mounted, the method comprising the steps of:

selectively holding one of a plurality of different types of image pickup devices each of which has a control mode which is different from other types of image pickup devices;

receiving from the attached image pickup device an identifying signal that identifies the type of image pickup device being held, the identifying signal specifying a pan head operation; and

controlling said pan head based on the identifying signal.

59. A method according to claim **58**, wherein the identifying signal comprises a weight of said image pickup device.

60. A method according to claim **58**, wherein the identifying signal comprises a weight of a lens of said image pickup device.

61. A method according to claim **58**, further comprising:

controlling a driving voltage of said pan head for changing a direction of the image pickup device based on the identifying signal.

62. A method according to claim **58**, further comprising:

controlling a driving speed of said pan head for changing a direction of the image pickup device based on the identifying signal.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,445,410 B2
DATED : September 3, 2002
INVENTOR(S) : Kenji Kawano

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 5,
Line 46, "lib" should read -- 11b --.

Column 7,
Line 18, "open and shut" should read -- opening and shutting --.

Column 11,
Line 15, "devices;" should read -- devices; and --.

Column 15,
Line 52, "the" (1st occurrence) should read -- that --.

Signed and Sealed this

Eighteenth Day of February, 2003

JAMES E. ROGAN
Director of the United States Patent and Trademark Office

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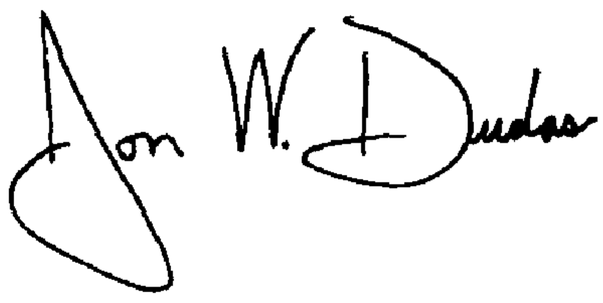
Twenty-eighth Day of June, 2005



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